III-15.01 Safety Clear Zones

Following is information on the Clear Roadside Concept, and design guides by which safety clear zones may be designed and necessary clear zone widths may be determined.

III-15.02 the Clear Roadside Concept

It is desirable to provide a highway recovery area free of obstructions that might be struck by errant vehicles. Studies have indicated that on high speed highways, a width of 30 feet or more from the edge of the traveled way permits about 80 percent of the vehicles leaving the roadway out of control to recover.

We try to provide a traversable and unobstructed roadside area extending beyond the edge of the through traveled way, particularly on high-volume, high-speed highways to the clear zone.

III-15.02.1 Roadside Geometry

If the roadside is not flat, a motorist leaving the roadway will encounter an embankment foreslope (negative grade), a cut slope or backslope (positive grade), or a roadside channel (change in slope from negative to positive). Each of these features has an effect upon a vehicle's lateral encroachment and trajectory as will be discussed herein.

III-15.02.2 Embankment Foreslopes (Parallel Slopes)

Embankments, or fill slopes, parallel to the flow of traffic may be defined as recoverable, non-recoverable, or critical. Recoverable slopes are all embankment slopes 1:4 or flatter. If such slopes are relatively smoothly traversable, the suggested clear zone distance may be taken directly from Table III-15-1. The factors in Table III-15-2 should be used to increase the clear zone accordingly where the roadway curves. Motorists who encroach on recoverable slopes can generally stop their vehicles or slow them enough to return to the roadway safely. Fixed obstacles, such as culvert headwalls, will normally not extend above the embankment within the clear zone distance.

A non-recoverable slope is defined as one which is traversable, but from which most motorists will be unable to stop or return to the roadway easily. Vehicles on such slopes typically can be expected to reach the bottom of the slope. Embankments between 1:3 and 1:4 generally fall into this category. Since a high percentage of vehicles will reach the toe of these slopes, the clear zone cannot be on this slope. Fixed obstacles will normally not be constructed on or along such slopes, and a clear run out area at the base is desirable.

A critical slope is one on which a vehicle is likely to overturn. Slopes steeper than 1:3 generally fall into this category. If a slope steeper than 1:3 begins closer to the traveled way than the

suggested clear zone distance for that specific roadway, a barrier might be warranted if the slope cannot be flattened.

For relatively flat and level roadsides, the clear zone concept is simple to apply. However, it becomes somewhat less clear when the roadway is in a fill or cut section, where the roadside slopes may be either positive, negative, variable, or where a roadside channel exists near the traveled way.

III-15.02.3 Embankment **Cross Slopes (Perpendicular to Travel)**

Common obstacles on the roadsides are embankment slopes created by median crossings, ditch blocks, driveways, or intersecting side roads. These are generally more critical to errant motorists than foreslopes or backslopes because they are perpendicular to travel and typically are struck head on by run-off-the-road vehicles. Cross slopes of 1:8 are to be used.

Embankment cross slopes of 1:6 are used in urban areas, because of the generally lower travel speeds.

The side slopes of median crossings and ditch blocks shall be 1:10.

III-15.02.4 Embankment Backslopes (Parallel Slopes)

When a highway is in a cut section, the backslope may be traversable dependent upon its relative smoothness, and presence or absence of fixed obstacles. If the slope between the roadway and the base of the backslope is traversable (1:3 or flatter) and the backslope is obstacle-free, it may not be a significant obstacle, regardless of its distance from the roadway. Where the backslope consists of a steep, rough-sided rock cut, it should be located outside of the clear zone if cost effective or shielded. A rock cut is considered to be rough-sided when the face will cause vehicle snagging rather than providing a smooth redirection.

III-15.02.5 Roadside Channels

A roadside channel is defined as an open channel paralleling the highway embankment and within the limits of the highway right-of-way. It collects runoff from the highway, and from areas that drain onto the right-of-way, and conveys the accumulated runoff to an outlet point. Figures III-15-1 and III-15-2 present preferred foreslopes and backslopes for basic ditch configurations.

A basic understanding of the clear zone concept is critical to the proper application. The numbers obtained from Table 1 imply a degree of accuracy that does not exist. The numbers obtained from the tables represent a reasonable measure of the degree of safety suggested for a particular roadside.

III-15.02.6 Recoverable Parallel Slopes

On new construction or major reconstruction, smooth slopes with no significant discontinuities and with no protruding fixed objects are desirable from a safety standpoint. It is desirable to have the top of the slope rounded so encroaching vehicles remain in contact with the ground. It is also desirable for the toe of the slope to be rounded to make it essentially traversable by errant vehicles.

III-15.02.7 Non-Recoverable Parallel Slopes

Embankment slopes of 1:3 up to 1:4 are considered traversable if they are smooth and free of fixed objects. However, since many vehicles on this slope will continue on to the bottom of the slope, a clear runout area is necessary beyond the toe of the non-recoverable slope. The extent of this clear runout area could be determined by first finding the available distance between the edges of the trough traveled way and the breakpoint of the recoverable foreslope to the non-recoverable foreslope. See Figure 2 in Appendix III-14 A.

III 15.02.8 Critical Parallel Slopes

Critical slopes are those steeper than 1:3. They will cause most vehicles to overturn and should be treated if they begin in the clear zone and meet warrants for shielding or flattening.

III-15.03 Recommended Design Practices

Where a roadway is being graded or reconstructed, the foreslopes should be constructed as in accordance with Section I–06 for the respective classification of roadway and the following:

(1) Where the speeds are high and the traffic volumes are high, the foreslopes should have a slope of 1:6 for 24 feet from the edge of the finished shoulder and beyond the clear zone, where the foreslopes are steeper than 1:4 and there is an obstacle, it is desirable to go beyond the clear zone with 1:12 or flatter, because the clear zone concept is based on the fact that approximately 20 percent of the vehicles leaving the roadway will go beyond the clear zone distance. High volumes are considered to be over 2000 ADT, and high speed is considered to be over 55 mph.

(2) Where the speed is high (over 55 mph), the volumes are over 1200 ADT, and the foreslopes are between 1:6 and 1:4 out to the edge of the clear zone, and beyond the clear zone the foreslopes are steeper than 1:3, it is desirable to go beyond the clear zone with 1:12 or flatter, because approximately 20 percent of the vehicles leaving roadway will go beyond the clear zone.

(3) Where the speed is between 40 mph and 55 mph, volumes are over 750 ADT, and the foreslopes are 1:4 out to the edge of the clear zone, and beyond the clear zone the

foreslopes are steeper than 1:3, it is desirable to go beyond the clear zone with 1:12 or flatter, because of the 20 percent of errant vehicles going beyond the clear zone.

(4) The 1:12 flattened area can be omitted if a cost-effectiveness analysis shows it is cost-effective to omit when done in accordance with the AASHTO Roadside Design Guide.

III-15.03.1 Cross-Drainage Structures

Cross-drainage structures are designed to carry water underneath the roadway embankment, and vary in size from 18 inch diameter concrete or corrugated metal pipes, to multi-barreled concrete box culverts or structural plate pipes with clear spans of 10 feet or more. Typically, their inlets and outlets consist of concrete headwalls and wing walls for large structures and beveled end sections for the pipes. They may represent an obstacle to motorists who run off the road. The options available to the designer to minimize these obstacles are:

(1) Use a traversable design.

(2) Extend the structure so it is less likely to be hit.

(3) Shield the structure.

(4) Delineate the structure if the above alternatives are not appropriate.